NOTES ON SOME INDIGENOUS SAGO AND TOBACCO FROM NEW GUINEA.

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SAGO.

This sample of Sago meal or flour was brought by Mr. Theodore Bevan from Evorra village, Jubilee River, 16 miles north-east of Bald Head. This locality had never, in all human probability, been visited by a white man before.

It is of course of native manufacture, and is from indigenous sago (*? Sabal Adansonii* which forms forests in New Guinea and New Ireland, or possibly *Sagus Konigii* and *S. læve*). Mr. Bevan took a photograph of natives engaged in the operation of making sago. (1) The following description, taken from Balfour's Cyclopædia of India, of the process as carried on in the Archipelago, serves fairly for a description of that which obtains in the interior of New Guinea, as described by Mr. Bevan to me, and as depicted in the photograph alluded to.

"A tree is cut down close to the ground, the leaves and leaf-stalks cleared away, and a broad strip of the bark taken off the upper side of the trunk. This exposes the pithy matter, which is of a rusty colour near the bottom of the tree, but higher up pure white, and about as hard as a dry apple. The pith is cut or broken down into a coarse powder (1) by means of a club of hard and heavy wood, having a piece of sharp quartz rock (2) firmly imbedded into its upper end. By successive blows, narrow strips of the pith are cut away till it falls down into the cylinder formed by the bark, leaving only a skin not more than half an inch in thickness (3). These pith-strips are then put into a washing-trough made of the large sheathing vases of the leaves, and the strainer is the fibrous covering from the leaf-stalks of the young cocoa-nut. Water is then poured on the mass of pith which is pressed against the strainer, and kneaded until all the starch is dissolved (*suspended*, sago, like any other starch, being insoluble in cold water, J.H.M.), and passes through into a trough with a depression in its centre, into which it is deposited, the surplus water trickling away. When the trough is nearly full, the mass of starch, which has a slightly reddish tinge, is made up into cylinders, wrapped up in sago leaves, and is the raw sago or sago meal."

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(1) At page 349, Vol. X. Proc. Linn. Soc. N.S.W., Miklouho-Maclay says that sago *Sagus sp.* ("Buam"), is regarded as a luxury on the Maclay coast, and is not used commonly as food. Mr. Bevan, however, reports sago to be plentiful in the district he visited.

Notes on the above description (communicated to me verbally by Mr. Bevan) :—

(1) Chips or small lumps would be better. The men form a heap, and the women gather it up.

(2) No stone was used by the natives Mr. Bevan saw in the act of making sago, only wooden flails or adzes. The chopping is done by men ; the women do the whole of the remainder of the sago-process.

(3) The remainder of the process may be described thus.—A spathe of sago-palm or cocoa-nut is supported, the broad end uppermost, on a wooden fork. The women take the chopped pith (see 1) put into the funnel-shaped cavity of the spathe, knead it well with the hands, at the same time allowing water to pass through the mass to carry off the grains of sago which are set free by the operation of kneading.

The following slightly different account of the operation of sago manufacture, as carried on in New Guinea, is taken from "A Voyage to New Guinea, &c," by Capt. Thomas Forrest, 2nd ed., 1780, p. 39, et seq.

"The sago or libby tree has, like the coco nut tree, no distinct bark that peels off, and may be defined as a long tube of hard wood, about two inches thick, containing a pulp or pith mixed with many long fibres. The tree being felled, it is cut into lengths of about five or six feet. A part of the hard wood is then sliced off, and the workman, coming to the pith, cuts across (generally with an adze made of hard wood called aneebong) the longitudinal fibres and the pith together, leaving a part at each end uncut, so that, when it is excavated, there remains a trough, into which the pulp is again put, mixed with water, and beat with a piece of wood; then the fibres, separated from the pulp, float on top, and the flour subsides. After being cleared in this manner by several waters, the pulp is put into cylindrical baskets, made of the leaves of the tree, and, if it is to be kept some time, those baskets are generally sunk in fresh water to keep it moist."

Another allusion to New Guinea sago (and this refers to a spurious one) is in Hassall's "Food and its Adulterations," in which occurs the passage :—"Pareira also states that he received from Professor Guibourt samples of "*Sagou des Maldives de Planche, donné par lui*, and, *Sagou de la Nouvelle Guinée, donné par lui*," and that he found them to be factitious sagos prepared from potato starch. The grains of the New Guinea sago were bright red on one side and whitish on the other."

It is well-known that France and Germany first taught Europe how to manufacture "pearl sago" out of potato starch, but the sample now before you is undoubtedly unsophisticated New Guinea sago, procured from a village the natives of which are probably ignorant of the arts of adulteration, which belong only to civilization.

In appearance and texture it reminds one strongly of the "Bath brick" so much used in England by domestics for polishing purposes. It is of a light buff colour, crumbling readily in the fingers into a flour. On keeping, it becomes of a light brown, or even a rusty colour, on the outside.

Mr. Bevan tells me the sample was moist and soft and capable of being cut with a knife when he received it. In that state it is ready to undergo the operation of granulating or "pearling."

This refinement, introduced at Singapore in 1819 by Chinese workmen, but in use in Malacca for many years previously, was known to New Guinea natives at least as early as 1777, Captain Forrest then describing the process in use. Balfour (*loc. cit.*) says that the Malays learnt the art from the natives of Bukit Batu (Siak). It therefore becomes interesting to learn how and when the operation became known to the natives of New Guinea, or whether in fact, the invention is owing to them.

Every writer on the subject of sago speaks in superlative terms as to the value of the palms as a crop. The matter is so frequently referred to that there is no difficulty in getting particulars on the subject. I will content myself with quoting one recent and eminent authority, viz: Mr. W. B. Pryer, Her Majesty's Consular Agent for Sandakan (Borneo) and Resident in the Service of the British North Borneo Company, who referred to the matter on the 25th October last, at a conference at the Colonial and Indian Exhibition. After alluding to the fact that three trees yield more nutritive matter than an acre of wheat, and six trees more than an acre of potatoes, he goes on to say :—"The main drawback to the investment of capital in sago planting is the length of time that elapses before the trees are ready to cut; but it must be understood that when they once commence yielding, they go on continually without cessation, so that the only expense attending their cultivation, when once they are in bearing, is the upkeep of fencing to keep out pigs. It is also to be added that the expense of planting is very small compared to the returns when once they begin to come in. It has been calculated that a plantation of 2000 acres would give a profit of £15,560 a-year. Since this calculation was made the price of sago has declined, but there is no chance of its not yielding a good profit to the grower. It is also to be remembered that the sale value of a newly planted sago plantation would rise heavily yearly."

The soil and climate of Borneo are very similar to that of New Guinea. Does not everything point to New Guinea as suitable for sago planting? The systematic culture of sago and tobacco in this new colony is worth trying, I would suggest; and at present this seems to be the most feasible method of utilizing its resources.

Hygroscopic Moisture.

The mean of my experiments gives 13·29 as the percentage of moisture which can be driven off at a temperature of 100° C.

Starch.

It contains 91·03 per cent of starch.

The method adopted has been that of Siegert, and consists in the conversion of the sago-starch into Dextrose (Dextro-glucose) by treatment with dilute sulphuric acid, and the estimation of this sugar by means of Fehling's Solution in the usual manner.

Another method adopted was that of Bungener and Fries, which consists in boiling the sago with 1° solution of salicylic acid; in this way all the starch is dissolved out. This gave 95·16 of starch, there being left 4·84 per cent. of a brownish flocculent insoluble substance which was not further examined. This method cannot be considered so satisfactory as the dextrose process, and to ensure absolute accuracy the salicylic solution should be treated with dilute acid and the dissolved starch converted into dextrose. Its simplicity however recommends it.

The above experiments were determined upon the sago dried at 100° C.

The only allusion to the quantity of starch in sago, I can find, is in Prof. Church's "Foods," in which he gives the percentage for sago (presumably ordinary pearl sago) tapioca, arrow-root, cornflour, and maizena at 83 (evidently an approximation, and only intended as such). This result refers to sago at the ordinary temperature of the air, and, taking 12 as the percentage of hygrometric moisture, we find the percentage of starch in ordinary sago to be 94·32 (calculated on the substance dried at 100° C).

MICROSCOPE.

This sago as seen under the microscope presents a very similar appearance to that depicted at fig. 116 of Hassall's "Food and its Adulterations." The hilum is well marked, the rings though faint are evident, the shape of the grains oval, oblong-oval, truncate-oval, and a few sub-triangular. I cannot resist comparing the shape and markings of some of the granules to fragments of earthworms snipped off with a pair of scissors.

TOBACCO.

Obtained by Mr. Theodore Bevan the explorer, in April last, from natives belonging to the village of Tumŭ, 50 miles north of Cape Blackwood, Gulf of Papua, New Guinea. It is plentiful.

It is wrapped in portion of a spathe of a sago palm, is sun-cured, and was prepared for local use or tribal barter by natives who, in all human probability, had never seen a white man. It consists of the leaves and petioles but of no other portions of the plant.

I submitted the sample to Mr. Hugh Dixson, one of our members, than whom, I suppose, there is no higher authority on the subject in New South Wales. He says:—"The specimen is evidently, as you surmise, the same species as the tobacco of commerce; if it has been at all crossed by an indigenous speciesit is to an imperceptible extent. The variety is that grown in the Eastern

Seas and China, of which the best is Manila (1) tobacco. It is essentially a cigar tobacco in contradistinction to a manufacturing tobacco, having a very decided cigar-tobacco flavour ; the strength of this flavour is remarkable, considering, as you say, and as it bears evidence of, being sun-cured.

"As a merchantable article it is next to useless, but more than interesting as a specimen, as it is almost certain that where that grew, an article would grow that would have at least a fair marketable value in England and the Continent."

There is no doubt whatsoever that New Guinea, in common with some other islands of the Eastern Archipelago, is capable of growing tobacco of high quality. I may cite the Report on the specimens of raw tobacco exhibited by the colony of North Borneo at the Colonial and Indian Exhibition, because the climate and soil of Borneo are so very similar to that of New Guinea. The

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(1) East Indian, Manila and Turkish tobaccos are the produce of *Nicotiana rustica*, Linn. American tobaccos are the produce of *N. Tabacum*. The leaves of *N. Tabacum* are tapering oval-lanceolate and sessile, those of *N. rustica* being ovate, cordate and stalked. Of these two species the former seems much the hardier, and in most countries when it is cultivated to any extent, has become acclimatised, springing up in great profusion, self-sown. The latter form, on the other hand, is rarely found to do this, and is thus met only under cultivation. See Reports on the Colonial and Indian Exhibition, Art. "Tobacco."

The species of the genus *Nicotiana* are all indigenous in America, except our *N. suaveolens*, which is to be found all over Australia. The lamina of the largest leaf of the New Guinea tobacco now under examination has a length of 9 inches, while the petiole is 2 inches long. The average length of the laminæ is, however, 7 inches. They are all ovate-lanceolate, rather obtuse and none subcordate, which latter characteristic is mentioned by Asa Gray (Syn: Flora North America) as belonging to *N. rustica*. The presence of a longish petiole at once excludes this tobacco from *N. Tabacum*, and of all the species described by Asa Gray it certainly comes nearest to *N. rustica*. It is not very remote (I speak of the foliage alone) from our *N. suaveolens* with its spathulate leaves, but in all the specimens of that species I have examined, the lower portion of the leaf tapers far more into the petiole than is the case with any leaf of this New Guinea tobacco. It is to be hoped that Mr. Bevan or some other explorer will procure whole plants of this far-inland tobacco in flower and fruit.

Report states, "The specimens were of a very superior quality, both in aroma and appearance. They are well-adapted for cigar-making, and were considered amongst the best in the Exhibition."

I have alluded elsewhere to the desirability of testing New Guinea for the growth of tobacco, and I cannot do better than make the following extracts from the Experts' Report to which I have above alluded.

"There is perhaps no more patent fact than that it is practically immaterial what seed is used; it is the chemistry of the soil that can alone ensure good tobacco. Not only does the tobacco raised in one country differ from that obtained in another, from the self-same seed, but this variation may be as great between the produce of one field and another within the same district. It is the merit of one country to produce mild and aromatic tobacco, of another strong tobacco, and even with the most careful manuring it may not be possible to overcome these distinctions. . . . . . . When seed is imported, a mongrel crop is produced the first season, partly flavoured with the soil. In the second year the crop is truer to the seed. The leaves keep in better preservation when ripe. They should not be green nor dead, nor should they be left open, but pressed to preserve the flavour."

For other particulars as to planting, cultivation, and preparation of the leaf, see the admirable Report referred to, also "New Commercial Plants," Part i. (Christy), Mr. Christy's paper being translated from a Constantinople original. As in this instance, so in others, I have referred to Turkish tobacco (in the absence of authentic information about Manila), because the species yielding it is probably identical with that from New Guinea.

Note.—All my results have been obtained with the tobacco dried at 100° C.

HYGROMETRIC MOISTURE.

My experiments give the hygrometric moisture in this tobacco during the first fortnight of August in Sydney, at between 8·11 (1) and 10·55 per cent.

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(1) This low result was obtained during a week of dry westerly winds.

It is obvious that these figures teach but little, and cannot rigidly be compared with others unless the hygrometric state of the atmosphere at each place of experiment be given in all cases.

Nevertheless it will be interesting to compare the following figures for hygrometric moisture:—Turkey (Dr. Letheby), 12 4 per cent; his other figures fluctuating between 10·8 for German, and 13·4 for Maryland. Professor Church give the average per centage of moisture in tobacco at 13 per cent. These results have doubtless all been obtained in the more humid atmosphere of England.

Extract (water).

It yields 49·36 per cent of extract to water at 100° C.

Dr. Letheby gives the yield of extract of Turkey tobacco at 60·6, and his sample contained 12·4 per cent of hygrometric moisture. Calculated upon the dry leaf this would of course give a percentage of 68·1. The other percentages he gives (on the tobacco at 60° F.) vary between 43·4 for Virginian to 64·4 for Maryland.

Swedish tobacco is said to yield 50-64 per cent. of extract of (Dingl: Polytech: Journ: CCXXV. 615).

Extract (Ammoniacal Ether).

Hygrometric moisture... ...	10·55
Chlorophyll and fat	6·2
Nicotine	1·8
Total per cent soluble in ether...	18·55

Ash.

It yields 18·7 per cent of ash.

Dr. Letheby gives the percentage of ash in Turkey tobacco at 10·6, and Watts' Dict. at from 17-23. In this work we have the ash of good Havana 16-16·8 (Letheby 18·6), inferior sorts, 17·8-19·4; Letheby's figures also give German the maximum of 22·6. Professor Church ("Foods," the South Kensington Museum handbook) gives the ash of tobacco at from 13 to 28 per cent.

The nature of the soil has of course much to do with the percentage of ash, as also of the ash-constituents ; no information is forthcoming as to the soil on which the sample now under examination was grown.

NICOTINE.

The tobacco contains 1·8 per cent of Nicotine.

The process adopted was that of Schlœsing, and consists in exhausting the leaf with ammoniacal ether in a suitable apparatus. The solvent is then evaporated, and the quantity of alkaloid determined by observing the amount of standard sulphuric acid it is capable of neutralising.